PAGE 6/11 * RCVD AT 12/17/2004 3:06:56 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/5 * DNIS:8729306 * CSID: * DURATION (mm-ss):03-16

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(54) Linerless double-coated pressure-sensitive adhesive tape.

(57) A linerless double-coated pressure-sensitive adhesive tape of the prior art is wound directly upon itself into a roll that can later be unwound without delamination or offsetting of adhesive. The novel tape differs from the prior tape in that the pressure-sensitive adhesive at each of its faces is substantially solvent-free, crosslinked alkyl acrylate polymer and can be aggressively tacky for uses requiring high-performance adhesion.

Also provided is a composite of two pressure-sensitive adhesive tapes which are releasably adhered together adhesive face to adhesive face and then put to individual uses. The tapes are separable because their facing adhesives are substantially solvent-free, crosslinked alkyl acrylate polymers which can be aggressively tacky for uses requiring high-performance adhesion.

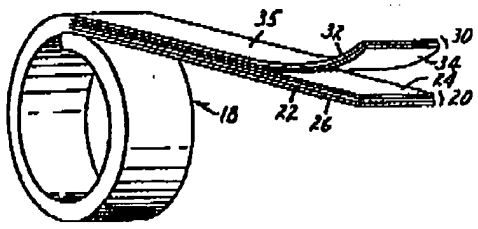

FIG. 2

EP 0 121 430 A2

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LINERLESS DOUBLE-COATED PRESSURE-SENSITIVE ADHESIVE TAPE

Field of the Invention

The invention concerns a linerless double-coated pressure-sensitive adhesive tape which can be wound directly upon itself into a roll for storage and shipment. The tape comprises a flexible support, at each face of which is a pressure-sensitive adhesive. The invention also concerns a composite having a first tape with a pressure-sensitive adhesive coating on both faces and a second tape with a pressure-sensitive adhesive coating on at least one face, the first and second tapes being releasably adhered together adhesive face to adhesive face.

Background Art

Almost all double-coated pressure-sensitive adhesive tapes are wound up with disposable, low-adhesion liners which are discarded when the tapes are unwound for use. Many double-coated tape dispensers are equipped to wind up the liner as the tape is dispensed. This not only makes the dispenser more expensive and awkward to handle, but the user must occasionally take the time to discard the wound liner. Disposal of the liner is especially troublesome in robotic systems.

U.S. Patent No. 2,889,038 (Kalleberg) discloses a linerless double-coated pressure-sensitive adhesive tape wound upon itself in roll form and comprising a flexible support having on opposite faces chemically different and physically incompatible pressure-sensitive adhesive layers. Although the Kalleberg patent calls both layers "aggressively tacky", the patented linerless transfer tape is not currently used when high performance is required. Even though Kalleberg tapes are currently on the market, it is believed that at the present time all double-coated pressure-sensitive adhesive tapes which have high performance are wound up with disposable, low-adhesion liners. Furthermore, the adhesive layers of the Kalleberg

PAGE 8/11 * RCVD AT 12/17/2004 3:06:56 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/5 * DNIS:8729306 * CSID: * DURATION (mm-ss):03-16

tapes being marketed have a mottled appearance, and it usually is necessary to limit the thickness of each layer to about 0.1 mm.

Disclosure of Invention

The invention concerns a linerless double-coated pressure-sensitive adhesive tape and a composite which incorporates a linerless double-coated pressure-sensitive adhesive tape, which tape like that of the Kalleberg patent comprises a flexible support, at each face of which is a pressure-sensitive adhesive. The tape can be wound directly upon itself into a roll that can later be unwound without delamination or offsetting of adhesive. The composite includes the linerless double-coated pressure-sensitive adhesive tape as a first tape and a second tape having a flexible support on at least one face of which is a pressure-sensitive adhesive layer, the first and second tapes being releasably adhered together adhesive face to adhesive face. Unlike the Kalleberg tape, the adhesive faces of the novel tape and the composite can have truly high performance and can have adhesive and cohesive values equal to those of any pressure-sensitive adhesive tape now on the market. Also, unlike the Kalleberg tape, the novel tape does not require chemically different and physically incompatible adhesives at the two faces of its flexible support and the composite does not require chemically different and physically incompatible adhesives at the releasably adhered faces of the first and second tape. Instead, unwindability in the novel tape and separability in the composite are attained in that the pressure-sensitive adhesive at each adhesive face

(a) is a polymer of predominantly alkyl acrylate, the alkyl groups of which have an average of four to twelve carbon atoms,

(b) is substantially solvent-free,

(c) is crosslinked, and

(d) affords at each face a 180° Peelback Value

PAGE 9/11 * RCVD AT 12/17/2004 3:06:56 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/5 * DNIS:8729306 * CSID: * DURATION (mm-ss):03-16

(as defined below) of at least 10 N/dm. By "substantially solvent-free" is meant that the pressure-sensitive adhesive contains less than three percent by weight of solvent. The pressure-sensitive adhesive is sufficiently crosslinked when, on attempting to dissolve in heptane at room temperature, the undissolved gel component exceeds 50%.

A pressure-sensitive adhesive which provides a 180° Peelback Value of only 10 N/dm may be characterized as moderately tacky, being just tacky enough to assure reliable adhesion to ordinary paper, metal, glass, plastic, and painted substrates. When the adhesive at each face of the linerless double-coated pressure-sensitive adhesive tape is aggressively tacky, the novel tape can nevertheless be readily unwound from a linerless roll without delamination or offsetting of adhesive, even after months of storage. When the adhesive at each face of the novel composite is aggressively tacky, its first and second tapes can nevertheless be readily peeled apart without delamination or offsetting of adhesive, even after months of storage. Each face of the novel tape can have a 180° Peelback Value as high as that of any pressure-sensitive adhesive tape now on the market, e.g., at least 30 N/dm.

It is surmised that if the adhesive were not substantially solvent-free, the solvent would allow the polymer chains to knit across adjacent convolutions during prolonged storage in roll form, such that perfect separation could no longer be assured. In the present state of the art, it would not be commercially feasible to coat a pressure-sensitive adhesive from solution and obtain a pressure-sensitive adhesive layer which is substantially solvent-free such that aggressively tacky adhesive layers could be reliably separated without delamination or offsetting of adhesive.

To keep the amount of solvent to a minimum, the novel tape and the tapes of the novel composite are preferably made using photopolymerization as in U.S. Patent

No. 4,181,752 (Martens et al). No solvents are used when doing so. Although there inevitably are impurities in the starting materials which may have a solvent effect, such impurities would not comprise as much as three percent by weight of the pressure-sensitive adhesive.

The preferred procedure for preparing the linerless double-coated pressure-sensitive adhesive tape comprises the steps of

(1) coating onto each face of a flexible support a substantially solvent-free photopolymerizable monomer mixture comprising an alkyl acrylate, the alkyl groups of which have an average of 4-12 carbon atoms, and a crosslinker, and

(2) then exposing each coating to ultraviolet radiation to polymerize the acrylate to provide a pressure-sensitive adhesive layer which

(a) is crosslinked and

(b) affords at each face a 180° Peelback Value of at least 10 N/dm.

The resulting double-coated pressure-sensitive adhesive tape can be wound up into roll form adhesive face to adhesive face and later unwound without delamination or offsetting of adhesive. When the flexible support of the double-coated tape is porous, it may be embedded in a single layer of pressure-sensitive adhesive. Whether or not the flexible support is porous, there may be a pressure-sensitive layer on each face of the support and those two layers may either be identical or different from each other.

The preferred procedure for making the novel composite comprises the steps of

(1) coating onto each face of a first flexible support a substantially solvent-free photopolymerizable monomer mixture,

(2) coating onto one face of a second flexible support a substantially solvent-free photopolymerizable mixture,

each said photopolymerizable mixture comprising an alkyl acrylate, the alkyl groups of which have an average of 4-12 carbon atoms, and a crosslinker, and

(3) exposing each coating to ultraviolet radiation to polymerize the acrylate to provide a pressure-sensitive adhesive layer which

(a) is crosslinked and

(b) affords at each face a 180° Peelback Value of at least 10 N/dm.

(4) superimposing the resulting two tapes adhesive face to adhesive face, thus providing the novel composite. Those two tapes can later be peeled apart without delamination or offsetting of adhesive.

When the first flexible support of the novel composite is porous, it may be embedded in a single layer of pressure-sensitive adhesive. Whether or not that flexible support is porous, there may be a pressure-sensitive layer on each face of the support and those two layers may either be identical or different from each other.

Preferably prior to the aforementioned step (1) and before adding the crosslinker, the photopolymerizable mixture is first partially polymerized by ultraviolet radiation to provide a syrup having a coatable viscosity, e.g., 300 to 20,000 centipoises. After adding the crosslinker, the syrup is coated out and then exposed to ultraviolet radiation in an inert environment to complete the polymerization while simultaneously crosslinking the polymer. An inert environment may be provided by plastic film overlays which are fairly transparent to ultraviolet radiation and have low-adhesion surfaces. Biaxially-oriented polyethylene terephthalate film which is about 75% transparent to ultraviolet radiation of 320 to 370 nm is very useful. If instead of covering the polymerizable coating, the polymerization is to be carried out in an inert atmosphere, the permissible oxygen content of the

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